Journal of Accounting, Finance & Management Strategy, Vol. 13, No. 1, Jun. 2018, pp105-156

The Effects of Internet Banking on Financial Performance: Evidence from the East Asian Countries

Shu-Ling Lin[1], Yen-Ting Yu[2], Chang-Chieh Wu[3] and Sheng-Chang Wu[4]

Abstract

In recent years, the rise and flourish of internet and e-commerce promoted Digital Finance development. As internet technology gradually mature, coupled with increasing internet popularity, consumer banking behaviors are shifting towards utilizing internet to process transactions. This study investigated the effect on internet banking on bank performance in the East Asian Region. Logistic regression models were established to determine potential variables that affected the likelihood of providing internet banking and the effect of implementing internet banking on financial data that would reflect bank's profitability. The results show that banks who situated in more economically developed county, possessed higher return on shareholder equity are more inclined to develop internet banking. But with the development of online banking, growth rate of return on equity of banks would be negatively affected, due to the nature of

[1] Corresponding author. Professor, Department of Information and Finance Management, College of Management. National Taipei University of Technology. Taiwan, R.O.C. Email: shuling@ntut.edu.tw; shulingntut@gmail.com.

2 Master, Department of Information and Finance Management, College of Management. National Taipei University of Technology, Taiwan, R.O.C.

[3] PhD candidate, Department of Information and Finance Management, College of Management. National Taipei University of Technology, Taiwan, R.O.C. Email: jacksonccwu@gmail.com

[4] PhD student, Department of Information and Finance Management, College of Management. National Taipei University of Technology, Taiwan, R.O.C. Email: arron1201@gmail.com

limited potential growth of the banking sector in developed countries.

Keywords: Internet banking, Financial performance, Return on equity (ROE), Return on assets (ROA), Cash ratio.

JEL classification numbers: C02, G21, G24

1. Introduction

Security First Network Bank (SFNB) was the world's first internet-only bank, which began its operation in 1995. Within a few months since its launch, SFNB gained around 10 million views on the internet. This was a groundbreaking result in the financial sector and a solid evidence to indicate that internet banking could take both convenience and security into account while breaking the limitations of physical space and time.

Finance digitalization was brought forth by the rise of World Wide Web (WWW) and development of e-commerce. In addition, increasing internet penetration (IP) in the modern society along with maturing internet technology has resulted in people's dependence on the internet thus changing the consumer habit of banking service: more transactions are conducted on mobile phones and computers. King coined the term Bank 3.0 and pointed out that "bank" is not merely a location, but a behavior. Consumers do not need physical locations but banking functions. King predicted that when consumer behavior is dependent on mobile devices, the bank that could provide the most transaction via mobile devices would be the future's largest bank. (King, 2012) Internet finance is a term related to the idea of Bank 3.0. For example, transport cost paid with online credit card transactions, online bank-to-bank transfer for internet shopping, and online purchase of currencies.

Business service and function of various financial agencies have gradually homogenized and become less distinct due to closing gaps among finance markets. Globalization is a trend which results in the promotion and innovation of finance products. According to Chen's report in 2002, banks are more likely to sell finance products than its original service because more timely and direct services were being provided

consumers.(Xiao-li Chen, 2002) Delivering diversified products can improve bank's competitiveness and share portion of the market. Compared to traditional banks, digital finance has eliminated the physical operation costs and benefited consumers with more favorable interest rates. Larger economy of scale and more rapid growth could be achieved with a more competitive price. Improved consumer loyalty would ensue with improved consumer benefits.

Banking sector as transformed under implementation of information technology innovations. Recently, information and communication technology (ICT)5 was recognized as one of the core elements in bank development. Salehi & Alipour (2010) mentioned that ICT is a newly emerged battleground for e-commerce and e-business industries, which is also a powerful motivator for global economy development. (Salehi & Alipour, 2010) Internet banking is the most prominent and popular of all developments. In a study performed by White *et al*., regions including North America, Latin America, Europe, and Asia-Pacific invested 241 billion U.S. Dollars in the information technology sector, achieving an overall growth rate of 4% (White *et al*., 2014). These technologies would be implemented in investment risk management, business model development, and digitalized finance service. In consumer's perspective, internet banking met their demands, therefore significant growth of digital finance occurred in the past 10 years. Digital finance developed under limited labor force in face of ever so increasing demand for banking service. Expansive growth of digital finance was a combined result of

[5] Information and Communication Technology: According to Organization for Economic Co-operation and Development (OECD), ICT is combination of information technology (e.g. computer sciences, information systems, software application) and communication technology (e.g. mobile communication, wireless communication, network switch). With the development of technology, two completely different fields gradually merged as one. Source: http://www.oecd.org/。

altered user habit, decreased internet banking cost, and increased internet banking highlight. Increasing number of users of internet banking made development of financial technology (FinTech)[6] the focus of finance development.

According to the International Telecommunication Union's (ITU, 2016[7]) "Measuring the Information Society Report", global internet penetration reached 47%, indicating about 3.9 billion people had access to internet. The ITU predicts by 2020, global internet penetration would reach 60%. A statistical study conducted by Juniper Network reported, as of 2016, around 1.2 billion people use mobile devices to perform internet banking tasks, and predicted that at the end of 2021 the population would reach 2 billion.

Financial institutions may provide consumers with necessary service via internet banking, breaking the limitation of time and physical space. Banks could automate the screening process, which would require fewer or no human resource to provide the service. Internet technology has improved dramatically in the past 10 years, but the development of internet banking still varied significantly across the globe. Limited literature reported on the correlation between internet banking and revenue with most studies focused on North American and European banking systems, due to more reliable source of information. Many studies have pointed out

[6] Financial Technology (FinTech): According to Wikipedia, Dublin, Ireland, based National Digital Research Center defied financial technology as a "financial business innovation", which may be used to refer broadly to the technology utilized in this field. FinTech can also be defined as an innovative solution that has a disruptive effect on the development of financial business model, product, process, and operative system. Source：https://zh.wikipedia.org/wiki/%E9%87%91%E8%9E%8D%E7%A7%91%E6%8A%80。

[7] International Telecommunication Union. Source: http://www.itu.int/zh/about/Pages/default.aspx

that internet banking improves revenue and efficiency (Cole, 2004; Delgado *et al*., 2007; DeYoung *et al*., 2002; Furst *et al*., 2002).

Most studies done on investigating internet banking and revenue focused on banks in the American and European region (Cole, 2004; Delgado *et al*., 2007; DeYoung *et al*., 2002; DeYoung, Lang, & Nolle, 2007; Furst *et al*., 2002; Hasan, 2002; Hernando & Nieto, 2007; Sullivan, 2000). Until only recently, studies on banks in developing countries were conducted (Kamau, 2016; Khrawish, 2011; Onay & Ozsoz, 2012). In addition, research samples were mostly centered in economically developed countries and targeted on individual level (Cole, 2004; DeYoung *et al*., 2002; DeYoung *et al*., 2007; Sullivan, 2000). Most of these studies included samples from a single country, except in two recent publications that investigated multiple European countries. (Takieddine & Sun, 2015; Tunay *et al*., 2015) Limited scholars have conducted investigations on internet banking on a multinational level since quantity and quality of most variables vary from country to country. Therefore, comparing and summing results of studies conducted at different countries was challenging. In this study, we discussed the influence of internet banking on revenue of 10 East Asian banks that engaged in internet banking. The objectives of this study are as follows:

Firstly, to investigate the overall influence of internet banking on financial performance in East Asian, in order to determine that if internet banking implementation after a certain amount of time negatively influenced their performance. In addition, to investigate if varied degree of economic development may result in variable influences of internet banking on East Asian countries. Finally, the implication provides the policy-making of internet banking for financial industry.

2. Literature Review

2.1 Definition of Internet Banking

Internet banking is the financial service provided to consumers using public or private internet gateways to access personal accounts for the most updated information. Consumers may utilize financial products and services provided by the bank via web browsers. Internet banking began developing in 1994. With the acquiescence from The Federal Reserve System, Security First Network Bank (SFNB), the first online-only bank formed by three banks in the Unites States of America, was launched in 1995. Since the official launch, SFNB reached over 10 million views within several months. This was a groundbreaking result in the finance sector and was a solid evidence to indicate that internet banking could take both convenience and security into account while breaking the limitations of time and physical space.

Multiple banks provided online banking because of increased service efficacy: more service could be provided in the same amount of time (Xie, 2014). This business model spread across the world. With increased internet accessibility, internet banking entered consumer's daily lives. Features of internet banking service include: product standardization, product diversification, online transactions encouragement, fund and stock trading account combination. Compared to traditional physical banks, internet banking's advantages include: online account opening, trading, and enquiry.

Internet banks can be classified into two categories: internet-only banks and traditional bank-based banks. Lu defined internet-only banks, also known as virtual banks, as banks that provides service via the internet without having physical branches that provides financial service and its

customer's saving and withdrawal of cash can be done via the ATM or other remote service passages (Lu, 2003). Internet-only bank has an operation license with a host computer located in an physical office (or any other location), and the address of the office is the bank's address.

With the development of technology, internet banking, as opposed to traditional banking, provides a new gateway for consumers, thereby increasing its convenience and leading to further development due to greater public acceptance (Hu, 2002). Banks, particularly small-scaled banks, that utilized internet banking as a gateway expanded at an exponential rate due to higher consumer acceptance. Internet banking provides opportunities for banks to develop diversified services. Yang *et al*. pointed out that banks now provides innovative financial services such as: e-billing, Financial Electronic Data Interchange (FEDI), e-check, and e-loan (Yang, 2007) Banks are more likely to provide cross-domain products and financial services to consumers. Increasing consumer number may result in higher consumer retention rate. In the perspective of an enterprise, the prime motive of providing diversified service is to increase operational efficiency, market share, and maintain market competitiveness.

2.2 Internet banking service on its financial performance

Furst *et al*. (2002) performed a study based on National Banks that were listed under the United States Department of Treasury's Office of the Comptroller of the Currency (OCC). Since the third quarter of 1999, 20% banks in the United States of America provided internet banking, but the asset value of those banks comprised 90% of the entire banking system and 94% of the petty cash deposits of the National Bank (Furst *et al*., 2002). This study predicted that by the beginning of 2001, 45% of National Bank would provide internet banking, with the asset value comprised 95% of the entire banking system and 93% of the petty cash deposits of the National

Bank. Consumer that utilized online banking was disproportionately distributed among few large banks. 36% of the total internet banking consumers was from five banks with the most number of clients. In contrast, petty cash deposit of those five banks only comprised 20% of the entire National Bank. Internet banking providers were more likely to profit, because these providers had more active business attitudes.

Online banking is a gateway that provides the same results as transactions conducted at physical banks. Users may perform tasks such as: deposit transfer, bill payment, investment, and load application. Different banks have varied views and strategies on internet banking. Small scaled banks viewed internet banking as an additional cost, since cost associated with website maintenance would directly decrease profit. However, some service providers believed that internet banking has a competition defense effect to prevent high-valued client loss. Internet banking can be a way to deceased operation cost and to improve bank's profitability, because average cost of internet banking transaction is 0.1 USD while traditional transactions would cost over 1 USD (DeYoung, Duffy & Denise, 2002).

Cole *et al*. (2004) indicated that internet banking is a financial gateway, creating potential for changes in the production process. Service characteristic and consumer behavior influence bank performance. Internet banking benefits from services such as credit card loans, small amount motor loans, and home mortgage loans, since these services may require screening of customers via internet banking with minimal human resources and no direct service. Consumers could access these services without the constraint of time and space. Banks could generate additional income from the decreased service costs. Accepting or declining loan applications may be based on fixed quantifiable information (such as applicant income, wealth, credit record, and value of mortgaged properties). Applicants may send these information to banks via third party credit evaluation

institutions for further evaluation. In comparison, services such as small business loans is not suitable for internet banking, since information provided by small business are not quantifiable into non-fixed information.

2.3 Literature Review on Developed and Developing Countries

Hasan (2002) indicated that close to 75% of Italian banks provided internet banking from 1993 to 2000. Besides, compared to small banks in France and Spain, Italian banks showed more initiatives in developing e-business and internet banking. Furthermore, banks of larger scale are more likely to develop internet banking than banks of smaller scale and members of chained banking system are more likely to develop internet banking than independent banks.

Using population census reports and economic traits to introduce internet banking can assist in ensuring consumer acceptance (Sullivan, 2000). In the Tenth Federal Reserve District, large bank enterprises were strongly prone to retail, while community banks were more prone to provide service online to attract customers. Community banks that provided internet banking had worse performance than those that did not. This may be attributed to the limited experiences on implementing internet banking in the early stage.

With the development of internet, e-commerce became more important and internet banking became one of the major services (DeYoung *et al*., 2007). Potential value of internet banking business model lies in the automation and business scale expansion, because automated process would require higher fixed cost which would in-turn lower variable costs. Applying e-commerce in banking may greatly reduce unit cost and increased business scale.

ICT had a positive impact on bank revenue, due to multiple benefits

brought to banks and users. It benefits the bank mainly through acquiring more deposit service income (DeYoung *et al*., 2007). Most internet banking users viewed internet banking as an additional gateway of the physical bank, not as a surrogate.

Internet banking service provided by Spanish banks was found to lower management costs (such as human resources, operational costs) (Hernando & Nieto, 2007). Time was required for internet banking to have an effect on revenue. After implementing internet banking, banking costs would decrease which would lead to increased profitability.

Internet technology had revolutionary changes in the past 10 years, but development of internet banking still varied greatly among countries. 41 studies were collected after searching "Internet banking", "online banking", and "electronic banking (e-banking)" on Google Scholar Search Engine. In those studies, emphases were mostly placed on individual level from a single country. Multinational study was difficult to perform due to varying variable quantity and quality (Takieddine & Sun, 2015).

33 European countries were sampled by Takieddine & Sun (2015). The study focused on the influence of economy, technology, and cultural factors on the spread of internet banking. Results indicated that factors affecting socio-economic and technology-related factors in online banking were completely influenced by the Internet. Ethnic culture is the main regulating factor on the spread of internet banking to different countries (Takieddine & Sun, 2015).

Tunay *et al*. (2015) studies 30 European countries to investigate the effect of internet banking on revenue. In the study, samples were split into three categories: 30 European countries, Euro Zone countries, and non-Euro Zone countries. Results indicated that internet banking had a

positive effect on profitability for banks in the Euro Zone, while no statistical significance was observed for banks in non-Euro Zone. This result was attributed mainly to the fact that Euro Zone countries had more developed internet banking business and developing nations had relatively immature infrastructure. With immature internet technology, consumers were more used to preforming banking business at traditional banks. A reason why the effect of internet banking on revenue was indeterminate in the non-Euro Zone banks was due to immature infrastructure and consumer habit.

Most literature available on internet banking and revenue were focused on banking systems in North America and Europe, mainly due to data availability. Early literatures rarely studied on developing countries, because degree of internet development varied among countries. Therefore, internet banking development was limited in developing countries.

Banks in Jordan, situated in the Middle East, was studied for internet banking by Khrawish & Al-Sa'di (2011) from 2000 to 2009. Samples were divided into three categories: early internet banking providers, recent internet banking providers, and non-internet banking providers. Results showed that providing internet banking recently did not significantly affect ROA or ROE, but increased the cost related to implementing internet banking. For early internet banking providers, improved profitability was observed, although not significant.

Currently, banks mainly provide financial service via internet banking. Onay & Ozsoz (2012) investigated the effect of internet banking on "physical" banks in developed markets. Study period spanned from 1990 to 2008 and focused on 18 Turkish banks. Effect of internet banking on deposit receipts, loan activity, and revenue under emerging markets was explored. Results indicated that internet banking income is positively

correlated with deposit receipts of physical banks. In addition, internet banking positively affected the profit, deposits, and loan level of physical bank branches; this is because internet banking promoted more human resources input to branches to provide service. Internet banking negatively affected banking profit, because internet banking increased competition, thereby decreasing interest income. Internet banks would eventually subsidize physical bank branches.

Kenyan banks that provided internet banking were also investigated (Kamau, 2016). 11 NSE listed business banks were sampled to investigate the effect of internet banking on revenue. Data were gleaned from yearly financial reports published from 2012 to 2015, totaling 4 years. Authors suggested that internet banking significantly affected Kenyan business banks, having positive effect on ROE and improving profitability per unit by 56.9%. Through internet banking, loan review process can be accelerated via mobilizing deposits, which greatly decreased operation cost, increased service efficiency, ultimately improved profitability.

İlyas *et al*. (2015) investigated banks in 23 developing countries that engaged in internet banking related service. The study analyzed the effect of internet banking on bank profitability. Results indicate that internet banking would result in poor performance of banks in developing countries due to high infrastructure and advertisement costs, as well as customer culture difference.

Leaping opportunities of the finance department development may be brought forth by decreasing the cost, increasing the breadth and quality, expanding availability of financial service. Internet banking will improve transparency and improve financial service competitiveness as reflected by decreased price. However, decreased interest rate, cost, and commission will ultimately result in decreased income.

3. Methodology

3.1 Research Period and Sampling

In this study, banks from 10 East Asian Countries were included Taiwan, South Korea, Japan, China, Singapore, Malaysia, Thailand, Indonesia, Philippines, and Hong Kong, to investigate the influence of internet banking on its financial performance under varied degree of economy development.

Research method and model establishment were performed according to the study performed by DeYoung *et al*. (2007), with modification, from 2014 to 2016, spanning over 3 years.

3.2 Data Source

The financial performance variables, including: Return On Assets (ROA), Return On Equities (ROE), Interest Income Ratio, Total Assets, Cash Equivalent, Investment Securities, Bank Loans, Bank Deposits, Other Total Liabilities, Total Equity. The above variables were all acquired from S&P Capital IQ Company Information. Gross National Income (GNI) of countries was acquired OECD publication. Internet penetration (IP) was acquired from ITU publication.

Table 3-1 represents the prevalence of internet banking service providers of 284 listed banks, of which 37 were from China, 12 from Hong Kong, 43 from Indonesia, 110 from Japan, 15 from South Korea, 12 from Malaysia, 17 from Philippines, 6 from Singapore, 20 from Taiwan, and 20 from Thailand. 243 banks provided internet banking, while 41 banks did not. Singapore had the highest percentage of banks that did not provide internet banking, totaling 50% of the banks without internet gateway. Indonesia had the second highest with 13 of 43 banks not providing

internet banking, while the other 30 banks provided internet banking. Of the samples from Hong Kong and Malaysia, only 1 bank did not provide internet banking. Japan had the most number of banks meeting the selection criteria, with 14 banks without internet banking and 87.27% of banks providing internet banking. 4 South Korean banks did not provide internet banking service: few banks did not have its own webpage, but most of these banks were agricultural banks of small scale. Most samples had webpages providing information about branch locations, but did not provide internet banking. Listed public banks from Taiwan and China all provided internet banking service.

(Insert Table 3-1 Here)

3.3 Methodology

Due to potential endogeneity problem, analysis process was divided into two steps. First, we examined potential factors that influenced internet banking availability, and then we analyzed the effect of internet banking on revenue.

In the first part, potential factors that influenced internet banking availability were analyzed. Since internet banking availability is susceptible to multiple external factors, we utilized the categorizing method published by DeYoung *et al*. and Hernando and Nieto to search and select matched variables from database. Factors that were determined to influence internet banking availability may be categorized into four categories: National Economy Status, Bank Scale, Bank Business Portfolio, and Bank Revenue. Gross National Income (GNI) is used to represent National Economy Status; Total Bank Assets for Bank Scale; Ratio of Loan to Assets and Deposits to Assets for Bank Business Portfolio; Return on Assets (ROA) and Return on Equity (ROE) for Bank Revenue. Test of

significance was performed to compare banks with and without internet banking to investigate the difference between factors that influence internet banking availability.

In this study, test of significance was performed on the entire East Asian Region and then on individual countries to determine the significance between internet banking providing and non-providing banks. Logistics regression was performed to investigate the correlation between potential factors and internet banking availability. Usage of internet banking (Internet) was the dependent variable; while, Gross National Income (GNI), Total Bank Assets (Assets), Loans-Assets Ratio (Loans/Assets), Deposits-Assets Ratio (Deposit/Assets), Return on Assets (ROA), and Return on Equity (ROE) were independent variables. The four influential factors were analyzed with regression mode to determine if they influenced intent banking usage (Internet). Model 1 to 5 was shown in Equation 1-5.

$$Logit(Internet_i) = \alpha + \beta_1 GNI_i + \varepsilon_i \quad (1)$$

$$Logit(Internet_i) = \alpha + \beta_1 Assets_i + \varepsilon_i \quad (2)$$

$$Logit(Internet_i) = \alpha + \beta_1 Loans/Assets_i + \beta_2 Deposits/Assets_i \quad (3)$$

$$Logit(Internet_i) = \alpha + \beta_1 ROA_i + \beta_2 ROE_i + \varepsilon_i \quad (4)$$

$$Logit(Internet_i) = \alpha + \beta_1 GNI_i + \beta_2 Assets_i + \beta_3 \frac{Loans}{Assets_i} + \frac{Deposits}{Assets}_i + \beta_5 ROA_i + \beta_6 ROE_i + \varepsilon_i \quad (5)$$

Where:

$Logit(Internet_i) = \frac{Internet_i}{1-Internet_i}$, $Internet_i$=1,0 ;

$Internet_i$: is a dummy variable. Internet=1 for banks providing internet banking, and Internet = 0 for banks not providing internet banking.

The influence of internet banking on revenue was discussed in the second part of this study. Literature indicated that internet banking had a positive impact on revenue. DeYoung *et al*. stated that internet banking could lower fixed cost and increase enterprise value (DeYoung *et al*., 2007). Internet banking increased ROA and ROE according to a study performed by Delgado *et al*. (2007). Limited studies have been done on developing countries until recently. In the Jordanian region, internet banking did not have a significant impact on revenue (Khrawish, 2011). Due to consumer cultural and infrastructure differences, internet banking had a negative effect on revenue, due to increased advertisement cost and infrastructure construction (Tunay *et al*., 2015).

İlyas *et al* (2015) pointed out that under excessive cost and expenses, internet banking would have a negative impact on the revenue. Therefore, in this study, we utilized the report by İlyas *et al*. (2015) as a comparison to investigate the effect of internet banking on revenue in East Asia to see if concordant results can be reached.

Using the same two references (DeYoung *et al*., 2007; Hernando & Nieto, 2007), ten financial data, that matched the variable search from database and variable sets were selected for the analysis of bank. Ten financial data were as follows: ROA, ROE, Interest Income-Assets Ratio (Interest Income/Assets), Total Bank Assets (Total Assets), Cash Equivalent-Assets Ratio (Cash Equivalent/Assets), Investment Securities-Assets Ratio (Investment Securities/Assets), Bank Loans-Assets Ratio (Bank Loans/Assets), Bank Deposits-Assets Ratio(Bank Deposits/Assets), Other Total Liabilities-Assets Ratio (Other Total

Liabilities/ Assets), and Total Equity-Assets Ratio (Total Equity/Assets). Using the innovative approach by other study, multiple countries were added as a variable and internet prevalence (IP) was included for analysis.

For country's economy development extent, GNI values of countries published by OECD were averaged and ranked (Table 3-2). Singapore was ranked first, Hong Kong second, and Japan third. For internet penetration extent, IP of countries published by ITU were averaged and ranked (Table 3-2). Japan was ranked first, South Korea second, and Singapore third.

(Insert Table 3-2 Here)

In this study, financial data[8] that began in 2014 and ended in 2016 was collected. Financial data of the three years was averaged. Initial value from 2014 was deducted from the average value.

$$\Delta Financial\ data_{i,j}(2014-2016) = Mean\ Financial\ data_{i,j}(2014-2016) - Financial\ data_{i,j}(2014) \quad (6)$$

Where i: 284 banks samples

j: 10 financial data

$Mean\ Financial\ data_{i.j}(2014-2016)$: represents the average of the j[th] financial variable (including: ROA, ROE, Interest Income-Assets Ratio (Interest Income/Assets), Total Bank Assets (Total Assets), Cash Equivalent-Assets Ratio (Cash Equivalent/Assets), Investment Securities-Assets Ratio (Investment Securities/Assets), Bank Loans-Assets Ratio

[8] Financial Data Includes: Return on Assets (ROA), Return on Equity (ROE), Interest Income-Assets Ratio (Interest Income/Assets), Total Bank Assets (Total Assets), Cash Equivalent-Assets Ratio (Cash Equivalent/Assets), Investment Securities-Assets Ratio (Investment Securities/Assets), Bank Loans-Assets Ratio (Bank Loans/Assets), Bank Deposits-Assets Ratio(Bank Deposits/Assets), Other Total Liabilities-Assets Ratio(Other Total Liabilities/Assets), and Total Equity-Assets Ratio (Total Equity/Assets), for more detail refer to Table 3-3

(Bank Loans/Assets), Bank Deposits-Assets Ratio(Bank Deposits/Assets), Other Total Liabilities-Assets Ratio(Other Total Liabilities/Assets), and Total Equity-Assets Ratio (Total Equity/Assets)) of the i^{th} bank.

$Financial\ data_{i,j}(2014)$: represents the j^{th} financial variable in the year 2014 of the i^{th} bank.

$\Delta Financial\ data_{i,j}\ (2014\ -\ 2016)$: Represents the deviation between the mean value of 2014 and 2016 of the j^{th} financial variable in the i^{th} bank.

Suppose if j variable represents ROA, $\Delta Financial\ data_{i,j}(2014-2016)$ would represent: Averaged ROA of i^{th} bank from the year 2014, 2015, and 2016, subtract the ROA from 2014.

Using test of significance on the difference between the average value and 2014 value, regression model was established based on studies reported by DeYoung *et al*. (2007) & Hernando & Nieto (2007). Since we wish to address the difference between countries other than just the East Asian region, internet penetration and country dummy variables were included. Since collinearity exists between internet penetration and dummy variable of countries, the two variables were analyzed in two separate regression models:

$$\begin{aligned}\Delta Financial\ data_{i,j}(2014-2016) &= \alpha+\beta_1 Internet_i+\beta_2 Financial\ data_{i,j}(2014)\\ &+\beta_3\Delta Financial\ data_{i,j}(2013-2014)+\beta_4 Assets_i\\ &+\beta_5 Equity_i+\beta_6 Internet\ Penetration_i+\varepsilon_i \qquad (7)\end{aligned}$$

$$\Delta Financial\ data_{i,j}(2014-2016) = \alpha + \beta_1 Internet_i + \beta_2 Financial\ data_{i,j}(2014) + \beta_3 \Delta Financial\ data_{i,j}(2013-2014) + \beta_4 Assets_i + \beta_5 Equity_i + \beta_6 Cnina + \beta_7 Japan + \beta_8 Hong\ Kong + \beta_9 Indonesia + \beta_{10} Korea + \beta_{11} Malaysia + \beta_{12} Philippines + \beta_{13} Singapore + \beta_{14} Taiwan + \beta_{15} Thailand + \varepsilon_i \quad (8)$$

Where i: 284 banks samples

j: 10 financial data

$\Delta Financial\ data_{i,j}\ (2014 - 2016)$: Represents the deviation between the mean value of 2014 and 2016 of the j[th] financial variable in the i[th] bank.

$Internet_i$: is a dummy variable, Internet=1 for banks providing internet banking; Otherwise = 0.

$Financial\ data_{i,j}(2014)$: represents the j[th] financial variable in the year 2014 of the i[th] bank.

$\Delta Financial\ data_{i,j}(2013-2014)$: represents the difference between the 2014 and 2013 value of the j[th] financial variable of the of the i[th] bank.

$Assets_i$: Total Bank Asset

$Equity_i$: Total Owner's Equity

$Internet\ Penetration_i$: Internet Penetration

China: Dummy variable. Banks in China = 1; Otherwise = 0.

Hong Kong: Dummy variable. Banks in Hong Kong = 1; Otherwise = 0.

Indonesia: Dummy variable. Banks in Indonesia = 1; Otherwise = 0.

Japan: Dummy variable. Banks in Japan= 1; Otherwise = 0.

Korea: Dummy variable. Banks in South Korea = 1; Otherwise = 0.

Malaysia: Dummy variable. Banks in Malaysia = 1; Otherwise = 0.

Philippines: Dummy variable. Banks in Philippines = 1; Otherwise = 0.

Singapore: Dummy variable. Banks in Singapore = 1; Otherwise = 0.

Taiwan: Dummy variable. Banks in Taiwan = 1; Otherwise = 0.

Thailand: Dummy variable. Banks in Thailand = 1; Otherwise = 0.

4. Empirical Results

4.1 Potential Factors Influencing Internet banking availability

Potential factors were categorized into four categories and included representative variables for each category. Results of test of significance were shown in Table 4-1 to show the effect of providing or not providing internet banking on each variable: National Economy Status, Bank Scale, Bank Business Portfolio, and Bank Revenue. From our results, we could see that banks that provided internet banking had lower Loans-Assets ratio, higher Return on Assets and Return on Equity.

(Insert Table 4-1 Here)

Test of significance by DeYoung *et al*. reported that Total Bank Assets was positively correlated with internet banking availability, but nonsignificant correlation was seen in East Asian Region. *(R. DeYoung et al*., 2007)

Literature showed Bank Deposits-Assets Ratio and Loan-Assets Ratio were significantly negatively correlated to internet banking, but only Loan-Assets Ratio was negatively correlated. No significant influence of Deposits-Assets Ratio was observed. In accordance to the literature, ROA was positively correlated in the East Asian region.

Table 4-2 represents results of test of significance of providing internet banking on influencing variables. In Hong Kong, banks provided internet banking had higher ROA and ROE, which was compatible with the Bank Revenue section in Table 4-1. In Indonesia, banks provided

internet banking had higher total assets and lower loan-assets ratio and ROE. Lower loan-assets ratio and ROE were compatible to the Bank Business Portfolio section in Table 4-1. In South Korea and Malaysia, banks that provided internet banking had higher loan-assets ratio. In the Philippines, banks that provided internet banking had higher total assets, which was in concordance with the results of Indonesian banks. In Singapore, banks that provided internet banking had higher total assets and ROE, but lower ROA. In Thailand, banks provided internet banking had lower assets, ROA, and ROE.

(Insert Table 4-2 Here)

Logistic regression of variables (Table 4-3) from four categories on internet banking availability was performed separately, with the formulae indicated as below:

(Insert Table 4-3 Here)

$$Logit(Internet_i) = \alpha + \beta_1 GNI_i + \varepsilon_i \quad (1)$$

$$Logit(Internet_i) = \alpha + \beta_1 Assets_i + \varepsilon_i \quad (2)$$

$$Logit(Internet_i) = \alpha + \beta_1 Loans/Assets_i + \beta_2 Deposits/Assets \quad (3)$$

$$Logit(Internet_i) = \alpha + \beta_1 ROA_i + \beta_2 ROE_i + \varepsilon_i \quad (4)$$

$$Logit(Internet_i) = \alpha + \beta_1 GNI_i + \beta_2 Assets_i + \beta_3 \frac{Loans}{Assets_i} + Deposits/Assets_i + \beta_5 ROA_i + \beta_6 ROE_i + \varepsilon_i \quad (5)$$

Where:

$Logit(Internet_i) = \frac{Internet_i}{1-Internet_i}$, $Internet_i$=1,0 ;

$Internet_i$: is a dummy variable, Internet=1 for banks providing internet banking; Otherwise = 0.

In the Bank Scale Model (Model (2)), Bank asset variable's coefficient (0.0001) significantly at 1%, imply that increasing likelihood of developing internet banking with increased Assets. In the Bank Business Portfolio Model (Model (3)), Loan-Assets Ratio's coefficient (-0.2354) was negative significantly, Deposits-Assets Ratio's coefficient (1.5757) was positive significantly at 1% and 10% respectively. This indicates that banks with less loan and more deposits are more likely to provide internet banking. In the Bank Revenue Model (Model (4)), ROE's coefficient (0.0923) was positive significantly at 1%, indicating increasing likelihood of developing internet banking with increased ROE. In the full Model (Model (5)), GNI's coefficient (0.0000) and Assets' coefficient (0.0000) were positive significantly. Loan-Assets Ratio's coefficient (-1.7205) was negative significantly, ROE's coefficient (0.0794) was positive significantly. The results imply that increased likelihood of developing internet banking with higher GNI, Assets and ROE and with lower loan-assets ratio.

Countries were analyzed individually and tabulated in Table 4-4. In Hon Kong's Bank Revenue (Model (4)), ROA's coefficient (-1.1396) was negative significantly at 10%, imply that banks with lower ROA were more likely to develop internet banking. In Indonesia's Bank Scale (Model (2)), asset's coefficient (0.0001) was positive significantly at 5%, indicating banks of larger scale more like likely to develop internet banking; in Bank Business Portfolio Model (Model (3)), loan-assets ratio's coefficient (-3.3388) was negative significantly at 5%, indicating banks with lower loan-assets ratio were more likely to develop internet banking; in Bank Revenue Model (Model (4)), ROA's coefficient (-0.8890) was negative significantly and ROE's coefficient (0.1423) was positive significantly at 10% and 5%, respectively, indicating banks with ROA and higher ROE were more likely to develop internet banking; in full Model (Model (5)), GNI's coefficient (0.0001) was positive significantly, Asset's

coefficient (-3.2954) was negative significantly, deposits-assets ratio's coefficient (-0.8989) was negative significantly, and ROA's coefficient (0.1212) was positive significantly, indicating that higher GNI and ROA, lower bank asset and deposit-asset ratio would urge the nation to develop internet banking.

(Insert Table 4-4 Here)

In Japan, no significance was noted in Model (1) to (4), but in the full Model (Model (5)), ROA's coefficient (40.3366) was positive significantly and ROE (-1.5341) was negative significantly, both reaching 5% level of significance. This indicates that higher ROA and lower ROE will urge banks to develop internet banking.

Models (1), (3), (4), and (5) were not significant when analyzing Philippines, but in Bank Scale Model (Model (2)), Asset's coefficient (0.0005) was positive significantly at 10%, indicating banks with larger assets are more likely to develop internet banking.

Models (1), (2), (4), and (5) were not significant when analyzing Thailand, but in the Bank Business Portfolio Model (Model (3)), Load-Assets Ratio's coefficient (-16.278) and Deposit-Assets Ratio's coefficient (-0.3973) were negative significantly, both reaching 10% level of significance, indicating banks with lower loan and deposits to assets ratio are more likely to develop internet banking.

4.2 The effects of internet banking on financial performance

Test of significance will be performed to determine the influence of internet banking on revenue. Financial data of banks with internet banking will be compared to those without: first comparing financial data in 2014 then comparing the difference between the average in 2014, 2015, and

2016 and value in 2014. Various financial data were placed in the regression model to see if development of internet banking would influence revenue. İlyas *et al*. (2015) reported that internet banking had a negative influence in developing countries.

Table 4-5 represents the results of test of significance indicating the influence of 10 financial data (including: including: Return on Assets (ROA), Return on Equity (ROE), Interest Income-Assets Ratio (Interest Income/Assets), Total Bank Assets (Total Assets), Cash Equivalent-Assets Ratio (Cash Equivalent/Assets), Investment Securities-Assets Ratio (Investment Securities/Assets), Bank Loans-Assets Ratio (Bank Loans/Assets), Bank Deposits-Assets Ratio (Bank Deposits/Assets), Other Total Liabilities-Assets Ratio (Other Total Liabilities/Assets), and Total Equity-Assets Ratio (Total Equity/Assets)) on internet banking in the year of 2014. According to Table 4-5, banks comparing internet banking had lower Interest Income-Assets Ratio, Cash Equivalent-Assets Ratio, Bank Loans-Assets Ratio, and Other Total Liabilities-Assets Ratio; while ROA, ROE, and Total Bank Assets were higher.

(Insert Table 4-5 Here)

Table 4-6 represents analyses of individual countries in East Asia of the financial data in 2014, testing the significance of ten financial variables between banks with and without internet banking. In Hong Kong, banks providing internet banking had higher ROA and ROE and lower other liability-assets ratio. In Indonesia, banks providing internet banking had higher ROE and Total Bank Assets. In Japan, Philippines and Thailand, banks that provided internet banking did not show any significantly different financial data in 2014 compared banks that did not. In Singapore, banks that provided internet banking had lower ROA and Equity Ratio and higher ROE and Total Assets.

(Insert Table 4-6 Here)

Table 4-7 represents the test of significance of the average change in ten financial data from 2014 to 2016 between banks with and without internet banking of East Asia. According to the results, banks providing internet banking had higher total assets and deposits-Assets ratio and lower Security-Assets Ratio.

(Insert Table 4-7 Here)

Table 4-8 represents the test of significance of the average change in ten financial data from 2014 to 2016 between banks with and without internet banking of individual countries. In Hong Kong, banks that provided internet banking had higher amount of change in Security-assets ratio. In Indonesia, banks that provided internet banking had higher amount of change in interest income-asset ratio and smaller amount of change in securities-assets ratio. In Japan, banks that provided internet banking had higher amount of change in interest income-assets ratio, cash-assets ratio, loans-assets ratio, deposits-assets ratio, and equity-assets ratio. In the Philippines, banks that provided internet banking had smaller amount of change in securities-assets ratio. In Singapore, banks that provided internet banking had small amount of change in ROA.

(Insert Table 4-8 Here)

Using the regression model established in this study, we investigated the influence of internet banking on bank revenue. Since Internet Penetration and Country Dummy Variable have collinearity, therefore regression study was divided into two parts. Formula (7) deals mainly with Internet Penetration and Formula (8) with Country Dummy Variable.

$$\Delta Financial\ data_{i,j}(2014-2016) = \alpha + \beta_1 Internet_i + \beta_2 Financial\ data_{i,j}(2014) + \beta_3 \Delta Financial\ data_{i,j}(2013-2014) + \beta_4 Assets_i + \beta_5 Equity_i + \beta_6 Internet\ Penetration_i + \varepsilon_i \quad (7)$$

Results of Model (7) were represented in Table 4-9. Model (1) to (10) were established based on 10 different financial data, namely: growth rate of: Return on Assets (ROA), Return on Equity (ROE), Interest Income-Assets Ratio (Interest Income/Assets), Total Bank Assets (Total Assets), Cash Equivalent-Assets Ratio (Cash Equivalent/Assets), Investment Securities-Assets Ratio (Investment Securities/Assets), Bank Loans-Assets Ratio (Bank Loans/Assets), Bank Deposits-Assets Ratio (Bank Deposits/Assets), Other Total Liabilities-Assets Ratio (Other Total Liabilities/Assets), and Total Equity-Assets Ratio (Total Equity/Assets). In these models, the main independent variable is internet banking and dependent variables include financial data, total bank assets (Assets), Bank Equity (Equity), Internet Penetration (Internet Penetration). In Model (1), the dependent variable was the rate of growth of interest income, with the coefficient (0.0035) positively significant; this indicates that banks with internet banking had significantly higher rate of growth of Interest Income-Assets Ratio. In Model (2), the dependent variable was the rate of growth of ROA, with the coefficient (-0.4314) not significant; this indicates that banks with internet banking did not have significantly different rate of growth of ROA. In Model (3), the dependent variable was the rate of growth of ROE, with the coefficient (-0.4314) not statistically significant; this indicates that banks with internet banking did not have significantly different rate of growth of ROE. In Model (4), the dependent variable was the rate of growth of Total Bank Assets, with the coefficient (398.6266) not statistically significant; this indicates that banks with internet banking did not have significantly different rate of growth of Total

Bank Assets. In Model (5) and (6), the dependent variables were the rate of growth of cash-assets ratio and securities-assets ratio, respectively. The respective coefficients were -0.0235 and -0.0104 which were not statistically significant; this indicates that banks with internet banking did not have significantly different rate of growth of cash-assets ratio and securities-assets ratio. In Model (7) to (9), the dependent variable was the rate of growth of loan-assets ratio, deposits-assets ratio, and other liability-assets ratio, respectively. The respective coefficients were -0.0008, 0.0309, and 0.0037 which were not statistically significant; this indicates that banks with internet banking did not have significantly different rate of growth of loan-assets ratio, deposits-assets ratio, and other liability-assets ratio. In Model (10), the dependent variable was the rate of growth of equity-asset ratio, with the coefficient (-0.0349) negatively significant; this indicates that banks with internet banking had significantly lower rate of growth of equity-asset ratio.

In the case of dependent variable, internet penetrance coefficient was positively significant in only Model (9) and negative in all other models. In particular, coefficients in Model (1), (2), (3), (4), (5), (6), and (10), were statistically significant. Indicating greater internet penetration would result in lower rate of growth of revenue.

Summing up, banks with internet banking had higher rate of growth of interest income-asset ratio, but lower rate of growth of ROE, cash-asset ratio, securities-assets ratio, and equity-assets ratio.

Replacing Internet Penetration in Model (7) with Country Dummy Variables to get Model (8):

$$\Delta Financial\ data_{i,j}(2014-2016) = \alpha + \beta_1 Internet_i + \beta_2 Financial\ data_{i,j}(2014) + \beta_3 \Delta Financial\ data_{i,j}(2013-2014) + \beta_4 Assets_i + \beta_5 Equity_i + \beta_6 China + \beta_7 Japan + \beta_8 Hong\ Kong + \beta_9 Indonesia + \beta_{10} Korea + \beta_{11} Malaysia + \beta_{12} Philippines + \beta_{13} Singapore + \beta_{14} Taiwan + \beta_{15} Thailand + \varepsilon_i \quad (8)$$

Regression results of Model (8) are displayed in Table 4-10. Model (1) to (10) were established based on 10 different financial data, namely: growth rate of: Return on Assets (ROA), Return on Equity (ROE), Interest Income-Assets Ratio (Interest Income/Assets), Total Bank Assets (Total Assets), Cash Equivalent-Assets Ratio (Cash Equivalent/Assets), Investment Securities-Assets Ratio (Investment Securities/Assets), Bank Loans-Assets Ratio (Bank Loans/Assets), Bank Deposits-Assets Ratio (Bank Deposits/Assets), Other Total Liabilities-Assets Ratio (Other Total Liabilities/Assets), and Total Equity-Assets Ratio (Total Equity/Assets). In these models, the main independent variable is internet banking and dependent variables include financial data, total bank assets (Assets), Bank Equity (Equity), and Country Dummy Variables. Since most samples were collected from Japan, the intercept of these models was based on the Japan data.

In Model (1), the dependent variable was the rate of growth of interest income, with the coefficient (0.0043) positively significant; this indicates that banks with internet banking had significantly higher rate of growth of Interest Income-Assets Ratio. In Model (2), the dependent variable was the rate of growth of ROA, with the coefficient (-0.4524) negatively insignificant; this indicates that banks with internet banking did not have significantly different rate of growth of ROA. In Model (3), the dependent variable was the rate of growth of ROE, with the coefficient (-4.1520)

negatively significant; this indicates that banks with internet banking had significantly lower rate of growth of ROE. In Model (4), the dependent variable was the rate of growth of Total Bank Assets, with the coefficient (957.0272) positively insignificant; this indicates that banks with internet banking did not have significantly different rate of growth of Total Bank Assets. In Model (5), the dependent variable was the rate of growth of Cash-Assets Ratio, with the coefficient (-0.0154) negatively insignificant; this indicates that banks with internet banking did not have significantly different rate of growth of Cash-Assets Ratio.

Furthermore, in Model (6), the dependent variable was the rate of growth of Securities-Assets Ratio, with the coefficient (-0.0098) negatively significant; this indicates that banks with internet banking had significantly lower rate of growth of Securities-Assets Ratio. In Model (7), the dependent variable was the rate of growth of Loans-Assets Ratio, with the coefficient (0.0097) positively insignificant; this indicates that banks with internet banking did not have significantly different rate of growth of Loans-Assets Ratio. In Model (8), the dependent variable was the rate of growth of Deposits-Assets Ratio, with the coefficient (0.0437) positively insignificant; this indicates that banks with internet banking did not have significantly different rate of growth of Deposits-Assets Ratio. In Model (9), the dependent variable was the rate of growth of Other Liability-Assets Ratio, with the coefficient (-0.0001) negatively insignificant; this indicates that banks with internet banking did not have significantly different rate of growth of Other Liability-Assets Ratio. In Model (10), the dependent variable was the rate of growth of Equity-Assets Ratio, with the coefficient (-0.0271) negatively significant; this indicates that banks with internet banking had significantly lower rate of growth of Equity-Assets Rati.

Summing up, banks with internet banking had lower rate of growth of ROE, Securities-Assets Ratio, and Equity-Assets Ratio.

5. Concluding Remarks

The study incorporated listed banks from 10 East Asian Region as study targets. Study period spanning from 2014 to 2016 to investigate the effect of internet banking on its financial performance. Due to endogeneity problem of internet banking study analysis was divided into two parts for discussion.

Firstly, first paragraph of the 4th section discussed about factors that influences internet banking availability. From Model (5) and Table 4-3, we see that overall in the East Asian Region (composed of the ten countries of study: China, Hong Kong, Japan, South Korea, Malaysia, Philippines, Singapore, Taiwan, and Thailand) banks in countries of higher degree of economy development and ROE are more inclined to provide internet banking.

Secondly, the effect of internet banking on revenue was investigated. In Table 4-9, internet penetration was included in the model. We could see that Internet Penetration had significant influence on Revenue by negatively affecting the rate of growth of Interest Income-Assets Ratio, ROE, and Cash-Assets Ratio.

(Insert Table 4-9 Here)

In Table 4-10, Internet Penetration variable was replaced with Country Dummy Variable. From this model we would see that internet banking had significant influence on financial performance, particularly negatively affecting the rate of growth of ROE, which was compatible with the model in Table 4-9. Model (1) of Table 4-10 indicated that Japan had negative growth of Interest Income-Assets Ratio. Chang pointed out that Japan's economy still showed no signs of improvement in 2015, starting high ending low with multiple ups and downs and minimal GDP growth.

(Ji-feng Zhang, 2016) Due to Japan's prolonged low interest rate policy and the implementation of negative interest rate system since 2016/01/29, Japanese banks had negative Interest Income-Assets Ratio growth rate. (Zhong-hua Shen, 2016) Utilizing Japan as the reference value, rate of growth of Interest Income-Assets Ratio was positively significant in the Philippines, Thailand, and Indonesia. While Japan's internet penetration was the highest of the ten countries, internet penetration of the Philippines, Thailand, and Indonesia were ranked 8th, 9th and 10th in the ten countries. In addition, economy development status of those three countries was ranked in the bottom three too. Internet penetrations can be viewed as a substitute variable for economy development: with high internet penetration, banks are more robustly developed, therefore limited growth for Interest Income-Assets Ratio. Interest Income-Assets Ratio growth of banks in developing countries is the result of more growth potential of the Interest Income-Assets Ratio. In Model (2), rate of growth of ROE was only positively significant in China and Thailand, since developing countries have more potential resulting in more significant growth. In Model (5), Cash-Assets Ratio in multiple countries had negative growth, such as Japan, China, South Korea, Malaysia, Philippines, Singapore, Taiwan, and Thailand. Banks with higher Interest Income-Assets Ratio are more prone to provide cash loans to acquire more income, explaining the negative growth of Cash-Assets Ratio.

(Insert Table 4-10 Here)

Three important implications were reached in this study as follows：

Firstly, many scholars have investigated the effect of internet banking on revenue, including Sullivan *et al.*(2000), Claessens *et al.*(2002), DeYoung *et al.*(2007), (Alhudaithy & Kitchen, 2009; Khrawish *et al.*, 2011; Takieddine *et al.*, 2015; Boateng *et al.*, 2016). In this study we

discovered that internet banking had significantly negative influence on the growth rate of ROE, which was compatible with the results reported by İlyas *et al*. (2015), but had a positive influence overall on ROE.

Secondly, banks situated in more economically developed countries and higher ROE are more prone to provide internet banking. However, the availability of internet banking negatively influenced the rate of growth of ROE, since banks in developed countries had limited growth potential and was therefore less prominent than banks in developing countries.

Finally, development of internet banking is an inevitable process. Boateng *et al*. (2016) pointed out that internet social activity function significantly affected the will of internet usage. Internet banking platform encourages interaction with consumers. In an era when consumers are accustomed to internet social interaction, providing internet banking attracts more consumers. Alhudaithy & Kitchen（2009）discovered that internet banking is an interaction platform, where consumers continuously interact with bank's host computer to perform a series of bank business smoothly. Therefore, social environment encourages consumers to utilize internet banking. However, when internet banking increases bank-bank competition, leading to lower profit margin, a bank should search for innovation and novel income sources to increase its competiveness and maintain its position in the face of ever so advancing technology.

Most previous studies have been performed on banks in North American and European Countries and focused solely on single country or small region, since data collection increases if sample were to include multiple countries due to different variable quantity and nature. Sample size is a limitation in this study. Not all banks provided complete financial data profile, therefore only listed banks with complete profile of the selected countries were sampled into this study.

Reference

[1] Alhudaithy, A. I., & Kitchen, P. J. (2009). Rethinking models of technology adoption for internet banking: The role of website features. *Journal of Financial Services Marketing, 14*(1), 56-69.

[2] Boateng, H., Adam, D. R., Okoe, A. F., & Anning-Dorson, T. (2016). Assessing the determinants of internet banking adoption intentions: A social cognitive theory perspective. *Computers in Human Behavior, 65*, 468-478.

[3] Chen, X. L. (2002). China trust online banking: High network customer loyalty and low access costs. Retrieved from https://www.ithome.com.tw/node/18612.

[4] Chen, Z. Z. (2007). Research on the development and risk control of China's e-banking business: Taking the United States and Taiwan for example, the outsourcing research report of the banking Bureau of the Executive Yuan Financial Supervision Committee for 2005. *GRB Project number PG9410-0243.*

[5] Claessens, S., Glaessner, T., & Klingebiel, D. (2002). *Journal of Financial Services Research, 22*(1/2), 29-61.

[6] Cole, R. A., Goldberg, L. G., & White, L. J. (2004). Cookie cutter vs. character: The micro structure of small business lending by large and small banks. *Journal of Financial and Quantitative Analysis, 39*(2), 227-251.

[7] Delgado, J., Hernando, I., & Nieto, M. J. (2007). Do European primarily internet banks show scale and experience efficiencies? *European Financial Management, 13*(4), 643-671.

[8] DeYoung, R., Duffy, Denise. (2002). The challenges facing community banks: Straight from the horses' mouths. *Federal Reserve Bank of Chicago Economic Perspectives*.

[9] DeYoung, R., Lang, W. W., & Nolle, D. L. (2007). How the internet affects output and performance at community banks. *Journal of Banking & Finance*, *31*(4), 1033-1060.

[10] Furst, K., Lang, W. W., & Nolle, D. E. (2002). Internet banking. *Journal of Financial Services Research*, *22*(1/2), 95-117.

[11] Hasan, I., Maccario, A.,& Zazzara, C. (2002). Do internet activities add value? The italian bank experience. *Berkley Research Center, New York University, Working Paper*.

[12] Hu, Z. C. (2002). Financial innovation and e-banking. *Cross-Strait Financial Quarterly*, *3*(1), 35-47.

[13] Hernando, I., & Nieto, M. J. (2007). Is the internet delivery channel changing banks' performance? The case of Spanish banks. *Journal of Banking & Finance*, *31*(4), 1083-1099.

[14] Dinh, V., Le, U., & Le, P. (2015). Measuring the impacts of internet banking to bank performance: Evidence from Vietnam.. *Journal of Internet Banking and Commerce*, *20*(2), 103.

[15] Kamau, D. M., & Oluoch, Josphat. (2016). Relationship between financial innovation and commercial bank performance in Kenya. *International Journal of Social Sciences and Information Technology*, *2*(4), 576-594.

[16] Khrawish, H. A., & AI.- Sa'di, N. M. (2011). The impact of e-banking on bank profitability: Evidence from Jordan. *Middle Eastern Finance and Economics*, *13*, 142-158.

[17] King, B. (2012). *Bank 3.0: Why Banking Is No Longer Somewhere You Go But Something You Do*: New York：John Wiley & Sons Inc.

[18] Lu, Z. M. (2003). Online banking development and impact. *Central Bank Quarterly.*

[19] Onay, C., & Ozsoz, E. (2012). The impact of internet-banking on brick and mortar branches: The case of Turkey. *Journal of Financial Services Research, 44*(2), 187-204.

[20] Salehi, M., & Alipour, M. (2010). E-banking in emerging economy: Empirical evidence of Iran. *International Journal of Economics and Finance, 2*(1), 201-209.

[21] Shen, C. H. (2016). The era of negative interest rates. *Cross-Strait Financial Quarterly, 4*(3), 91-108.

[22] Sullivan, R. J. (2000). How has the adoption of Internet banking affected performance and risk in banks? *Financial Industry Perspectives,* 1-16.

[23] Takieddine, S., & Sun, J. (2015). Internet banking diffusion: A country-level analysis. *Electronic Commerce Research and Applications, 14*(5), 361-371.

[24] Tunay, K. B., Tunay, N., & Akhisar, İ. (2015). Interaction between internet banking and bank performance: The case of Europe. *Procedia - Social and Behavioral Sciences, 195*, 363-368.

[25] White, G. R. T., Afolayan, A., & Plant, E. (2014). Challenges to the adoption of e-commerce technology for supply chain management in a developing economy: A Focus on Nigerian SMEs. In E-commerce Platform Acceptance (pp. 23-39). Springer, Cham.

[26] Xie, J. P. (2014). *Modern Investment Bank (4),* BEST-WISE PUBLISHING CO.

[27] Zhang, J. F. (2016). Recovery fatigue, a difficult Japanese economy. *People's Forum 6.*

Table 3-1 Banks Providing Internet Banking Service in the East-Asian 10 countries

Country	Number of Banks	With internet banking Internet=1	Without internet banking Internet=0
Total	284	243 (85.56%)	41 (14.43)
China	37	37 (100.00%)	0 (0.00%)
Hong Kong	12	11 (91.67%)	1 (8.33)
Indonesia	43	30 (69.77%)	13 (30.23%)
Japan	110	96 (87.27%)	14 (12.73%)
South Korea	15	11 (73.33%)	4 (26.67%)
Malaysia	12	11 (91.67%)	1 (8.33%)
Philippines	17	14 (82.35%)	3 (17.65%)
Singapore	6	3 (50.00%)	3 (50.00%)
Taiwan	20	20 (100.00%)	0 (0.00%)
Thailand	12	10 (83.33%)	2 (16.67%)

Source：S&P Capital IQ Database and this study

Table 3-2 Country's Economy Development Extent and Internet Penetration in the East-Asian 10 countries

Country	Average GNI (USD)	GNI ranking	Internet Penetration	IP Ranking
China	7,993.9013	7	50.0667%	7
Hong Kong	42,013.7827	2	79.6049%	5
Indonesia	3,502.9420	9	19.7054%	10
Japan	37,191.2513	3	90.3883%	1
South Korea	27,485.0830	4	87.7352%	2
Malaysia	9,956.6943	6	67.9098%	6
Philippines	2,877.0830	10	41.4633%	8
Singapore	54,309.2637	1	81.3774%	3
Taiwan	22,483.4543	5	80.0248%	4
Thailand	5,873.3010	8	39.0687%	9

Table 4-1 The T-Test of Variables that Influences Internet Banking in the East-Asian 10 countries: Full sample

Category	Variable	Total	Internet=0	Internet=1	t-test	
			[1]	[2]	[2]-[1]	
National Economy	GNI	22777.4629	22230.0540	22869.8240	0.4168	
Bank Scale	Assets	149079.8665	8624.8125	160220.7773	0.4168	
Bank Business Portfolio	Loans/Assets	0.5207	0.5839	0.5087	-3.1751	***
	Deposits/ Assets	0.7684	0.7672	0.7696	0.1719	
Bank Revenue	ROA (%)	0.6275	-0.6579	0.7290	4.6066	***
	ROE (%)	8.1623	0.3060	8.7849	7.3471	***

Note：***, **, and * indicates 1%, 5%, and, 10% level of significance respectively.

Table 4-2 The T-Test of Variables that Influences Internet Banking in the East-Asian 10 countries

Category	Variable	Total	Internet=0	Internet=1	t-test	
			[1]	[2]	[2]-[1]	
Hong Kong						
National Economy Status	GNI	42013.7827	42013.7827	42013.7827	0	
Bank Scale	Assets	60306.65	228.4	66521.6414	1.1757	
Bank Business Portfolio	Loans/Assets	0.3417	0.2391	0.3514	0.7679	
	Deposits/Assets	0.7283	0.7864	0.7263	-0.6455	
Bank Revenue	ROA (%)	-0.4801	-24.0333	2.0435	10.0129	***
	ROE (%)	4.641	-47.5	10.2275	10.4882	***
Indonesia						
National Economy Status	GNI	3502.942	3502.942	3502.942	0	
Bank Scale	Assets	8723.327	2111.6472	11367.9989	2.9006	***
Bank Business Portfolio	Loans/Assets	0.6139	0.6671	0.5908	-2.2116	**
	Deposits/Assets	0.766	0.7707	0.7641	-0.2899	
Bank Revenue	ROA (%)	3.39	0.4696	0.8923	1.2456	
	ROE (%)	27.4	1.3816	7.1291	2.1553	**
Japan						
National Economy	GNI	37196.0176	37191.2513	37196.7127	0.0171	

Category	Variable	Total	Internet=0 [1]	Internet=1 [2]	t-test [2]-[1]	
Status	Assets	125549.0575	31338.1	127287.2671	0.5524	
Bank Scale	Loans/Assets	0.5089	0.5156	0.5082	-0.1628	
Bank Business	Deposits/Assets	0.8124	0.8113	0.8126	0.0465	
Portfolio	ROA (%)	0.3584	0.2063	0.3607	0.6359	
Bank Revenue	ROE (%)	5.4581	5.0275	5.4646	0.3175	
South Korea						
National Economy	GNI	27485.083	27485.083	27485.083	0	
Status	Assets	144032.7838	149583.76	143165.4438	-0.1037	
Bank Scale	Loans/Assets	0.6212	0.7606	0.5748	-2.0462	*
Bank Business	Deposits/Assets	0.7302	0.7526	0.7241	-0.5735	
Portfolio	ROA (%)	0.6644	0.7245	0.6444	-0.3968	
Bank Revenue	ROE (%)	7.2943	4.2842	8.1973	1.9754	
Malaysia						
National Economy	GNI	9956.6943	9956.6943	9956.6943	0	
Status	Assets	51933.8861	14199.6	55364.2758	1.4399	
Bank Scale	Loans/Assets	0.5294	0.6191	0.5212	-0.6309	*
Bank Business	Deposits/Assets	0.7341	0.7113	0.7362	0.5242	
Portfolio	ROA (%)	1.0939	1.26	1.0788	-0.7682	
Bank Revenue	ROE (%)	11.4836	6.61	11.9267	1.804	
Philippines						
National Economy	GNI	2877.083	2877.083	2877.083	0	
Status	Assets	12130.7345	1513.4333	13684.4859	2.1138	**
Bank Scale	Loans/Assets	0.4873	0.3925	0.5076	1.3797	
Bank Business	Deposits/Assets	0.745	0.7285	0.7485	0.4124	
Portfolio	ROA (%)	0.4036	0.6248	0.3713	-0.161	
Bank Revenue	ROE (%)	8.2518	4.8617	8.7733	1.3144	
Singapore						
National Economy	GNI	54309.2637	54309.2637	54309.2637	0	
Status						
Bank Scale	Assets	211713.0917	21.9	282276.8222	10.731	***
Bank Business	Loans/Assets	0.4073	0.4407	0.385	-0.4668	
Portfolio	Deposits/Assets	0.6515	0.6473	0.6544	0.1821	
Bank Revenue	ROA (%)	1.5046	2.9917	1.0089	-3.2805	***
	ROE (%)	8.9034	3.137	10.8256	8.2617	***
Thailand						

Category	Variable	Total	Internet=0 [1]	Internet=1 [2]	t-test [2]-[1]	
National Economy Status	GNI	5873.301	5873.301	5873.301	0	
	Assets	40209.0727	80149.4	36215.04	-2.4409	**
Bank Scale	Loans/Assets	0.6415	0.721	0.6256	-1.0463	
Bank Business	Deposits/Assets	0.7037	0.7349	0.6974	-0.8498	
Portfolio	ROA (%)	1.2641	1.82	1.2085	-2.0779	**
Bank Revenue	ROE (%)	11.8718	16.9667	11.3623	-2.1669	**

Note: 1. ***, **, and * indicates 1%, 5%, and, 10% level of significance respectively.
2. All banks in Taiwan and China provided internet banking service therefore were not fit for the test.

Table 4-3 Factors Influencing Internet Banking in the East Asian 10 countries: Full sample

	National Economy		Bank Scale		Bank Business		Bank Revenue		Overall	
	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)	
α	1.7212	***	1.3374	***	2.0709	***	2.0050	***	1.9033	*
GNI	0.0000								0.0000	***
Assets			0.0001	***					0.0000	***
Loans/Assets					-2.4354		***		-1.7205	*
Deposits/Assets					1.5757	*			-0.1982	
ROA (%)							-0.1025		-0.3475	
ROE (%)							0.0923	***	0.0794	**

Note: ***, **, and * indicates 1%, 5%, and, 10% level of significance respectively.

Table 4-4 Factors Influencing Internet Banking in the East Asian 10 countries

Hong Kong	National Economy Status Model(1)	Bank Scale Model(2)	Bank Business Portfolio Model(3)	Bank Revenue Model(4)		Overall Model(5)
α	2.3979	0.9037	33.3996	10.7102	*	269.8578
GNI	0.0000					-0.0036
Assets		0.0006				0.0000
Loans/Assets			-346.9816			-318.1943
Deposits/Assets			245.0582			114.6197
ROA (%)				-1.1396	*	6.4884
ROE (%)				-0.1936		-3.1426
Indonesia	National Economy Status Model(1)	Bank Scale Model(2)	Bank Business Portfolio Model(3)	Bank Revenue Model(4)		Overall Model(5)

α	0.8362		0.3838		3.5518	**	0.8406	***	4.1086	
GNI	0.0000								0.0001	**
Assets			0.0001	**					-3.2954	*
Loans/Assets					-3.3388	**			-2.2103	
Deposits/Assets					-0.7673				-0.8989	*
ROA (%)							-0.8890	*	0.1212	*
ROE (%)							0.1423	**	4.1086	

Japan	National Economy Status		Bank Scale		Bank Business Portfolio		Bank Revenue		Overall	
	Model(1)		Model(2)		Model(3)		Model(4)		Model(5)	
α	1.8706		3.6984	***	7.9082	**	4.2465	***	7.4801	
GNI	0.0000								0.0003	
Assets			0.0000						0.0000	
Loans/Assets					178.0549				-1.6156	
Deposits/Assets					-6.6110				-16.5446	
ROA (%)							1.6504		40.3366	**
ROE (%)							-0.0987		-1.5341	**

South Korea	National Economy Status	Bank Scale	Bank Business Portfolio	Bank Revenue	Overall
	Model(1)	Model(2)	Model(3)	Model(4)	Model(5)
α	1.0116	1.1293	14.0308	-2.9187	13.9384
GNI	0.0000				0.0000
Assets		0.0000			0.0000
Loans/Assets			-15.3544		-15.5596
Deposits/Assets			-2.4157		-5.1806
ROA (%)				-5.2382	-4.9029
ROE (%)				1.1807	1.0565

Malaysia	National Economy Status	Bank Scale	Bank Business Portfolio	Bank Revenue	Overall
	Model(1)	Model(2)	Model(3)	Model(4)	Model(5)
α	2.3979	-0.0248	-0.8476	64.4637	36.5033
GNI	0.0000				0.0023
Assets		0.0001			-0.0004
Loans/Assets			-2.7732		-31.6516
Deposits/Assets			6.6837		68.7360
ROA (%)				-209.6924	-238.1967
ROE (%)				19.9149	20.9536

Philippines	National Economy Status	Bank Scale	Bank Business Portfolio	Bank Revenue	Overall
	Model(1)	Model(2)	Model(3)	Model(4)	Model(5)

α	1.5404	0.0207	2.0177	1.1133 *	161.9028
GNI	0.0000				-0.1234
Assets		0.0005 *			0.0407
Loans/Assets			2.8585		-132.5387
Deposits/Assets			-2.3986		262.3481
ROA (%)				-3.4678	-8.4302
ROE (%)				0.5292	-4.1543
Singapore	National Economy Status Model(1)	Bank Scale Model(2)	Bank Business Portfolio Model(3)	Bank Revenue Model(4)	Overall Model(5)
α	0.0000	-4.5423	-1.1490	-0.0117	-4.1995
GNI	0.0000				-0.0003
Assets		0.0000			0.0000
Loans/Assets			-1.7428		-3.5559
Deposits/Assets			3.4974		18.2625
ROA (%)				-10.5081	-0.4315
ROE (%)				1.0269	0.7614
Thailand	National Economy Status Model(1)	Bank Scale Model(2)	Bank Business Portfolio Model(3)	Bank Revenue Model(4)	Overall Model(5)
α	1.6094	11.2948	25.0799	10.1012	-1411.7454
GNI	0.0000				0.3872
Assets		-0.0001			-0.0025
Loans/Assets			-16.2788 *		-262.0511
Deposits/Assets			-16.9167 *		-525.2950
ROA (%)				-1.3107	212.0677
ROE (%)				-0.3973	-31.4331

Note: 1. ***, **, and * indicates 1%, 5%, and, 10% level of significance respectively.
2. All banks in Taiwan and China provided internet banking service therefore were not fit for regression test.

Table 4-5 The Significance of Financial Data in the East-Asian 10 countries during 2014: Full sample

Variable	Internet=0 [1]	Internet=1 [2]	t-test [2]-[1]	
Interest Income/Assets	0.0402	0.0197	(-10.2778)	***
ROA	-0.6579	0.7290	(4.6066)	***
ROE	0.3060	8.7849	(7.3471)	***
Assets	8624.8125	160220.7773	(2.4620)	**
Cash/Assets	0.0935	0.0755	(-1.7483)	*
Securities/Assets	0.0117	0.0145	(0.6914)	
Loans/Assets	0.5839	0.5087	(-3.1751)	***
Deposits/Assets	0.7672	0.7696	(0.1719)	
Other Liabilities/Assets	0.0203	0.0211	(0.1019)	
Equity/Assets	0.1944	0.0914	(-7.2809)	***

Note: ***, **, and * indicates 1%, 5%, and, 10% level of significance respectively.

Table 4-6 The Significance of Financial Data in the East-Asian 10 countries during 2014

Hong Kong	Internet=0 [1]	Internet=1 [2]	t-test [2]-[1]	
Interest Income/Assets	.	0.0171		
ROA	-17.2000	2.4643	(8.3633)	***
ROE	-30.8000	11.9940	(6.0824)	***
Assets	313.6000	61751.9700	(0.6207)	
Cash/Assets	0.0072	0.1064	(1.3294)	
Securities/Assets	0.0100	0.0140	(0.2305)	
Loans/Assets	0.0100	0.3485	(1.3956)	
Deposits/Assets	.	0.7324		
Other Liabilities/Assets	0.1476	0.0215	(-4.2241)	***
Equity/Assets	0.5179	0.2619	(-0.9979)	
Indonesia	Internet=0 [1]	Internet=1 [2]	t-test [2]-[1]	
Interest Income/Assets	0.0467	0.0391	(-1.2164)	
ROA	0.7576	1.2502	(1.4718)	
ROE	4.4131	10.0130	(2.1355)	**
Assets	1944.6750	11024.9667	(1.6867)	*
Cash/Assets	0.1176	0.1055	(-0.5504)	
Securities/Assets	0.0069	0.0042	(-0.7075)	
Loans/Assets	0.6863	0.5938	(-1.5075)	
Deposits/Assets	0.7938	0.7564	(-0.9431)	
Other Liabilities/Assets	0.0061	0.0303	(0.6714)	
Equity/Assets	0.1359	0.1291	(-0.4597)	

Japan	Internet=0 [1]	Internet=1 [2]	t-test [2]-[1]	
Interest Income/Assets	0.0115	0.0110	(-0.1989)	
ROA	0.1340	0.3712	(0.5427)	
ROE	3.5900	5.7216	(0.8098)	
Assets	33875.8000	122713.8336	(0.3323)	
Cash/Assets	0.0805	0.0813	(0.0154)	
Securities/Assets	0.0004	0.0050	(0.3873)	
Loans/Assets	0.5124	0.5075	(-0.0614)	
Deposits/Assets	0.8168	0.8146	(-0.0476)	
Other Liabilities/Assets	0.0224	0.0164	(-0.6986)	
Equity/Assets	0.0422	0.0713	(0.4249)	
South Korea	Internet=0 [1]	Internet=1 [2]	t-test [2]-[1]	
Interest Income/Assets	0.0178	0.0215	(1.1296)	
ROA	0.5190	0.9151	(0.8660)	
ROE	4.4285	10.7580	(1.2327)	
Assets	149237.8750	136105.2182	-(0.1671)	
Cash/Assets	0.0213	0.0217	(0.0927)	
Securities/Assets	0.0277	0.0213	-(0.6642)	
Loans/Assets	0.0350	0.5987	(-1.0014)	
Deposits/Assets	0.0704	0.7195	(-0.7431)	
Other Liabilities/Assets	0.0350	0.0419	(0.5528)	
Equity/Assets	0.0178	0.0215	(1.1296)	*
Malaysia	Internet=0 [1]	Internet=1 [2]	t-test [2]-[1]	
Interest Income/Assets	0.0145	0.0170	0.690723	
ROA	1.5200	1.3200	-0.36399	
ROE	8.3400	15.2691	1.164158	
Assets	15166.7000	60202.6909	0.802374	
Cash/Assets	0.0403	0.0734	0.909537	
Securities/Assets	0.0748	0.0382	-1.06343	
Loans/Assets	0.6154	0.5421	(-0.2699)	
Deposits/Assets	0.6898	0.7365	(0.5975)	
Other Liabilities/Assets	0.0094	0.0323	0.641003	
Equity/Assets	0.1196	0.0926	-1.32597	
Philippines	Internet=0 [1]	Internet=1 [2]	t-test [2]-[1]	
Interest Income/Assets	0.0328	0.0306	(-0.2174)	
ROA	0.5920	0.9455	(0.4275)	
ROE	4.5450	9.8285	(1.0208)	
Assets	1448.5500	12604.0879	(1.1113)	
Cash/Assets	0.0628	0.1507	(0.6715)	

Securities/Assets	0.0063	0.0203	(0.8397)	
Loans/Assets	0.4266	0.5102	(0.5802)	
Deposits/Assets	0.7462	0.7431	(-0.0331)	
Other Liabilities/Assets	0.0096	0.0090	(-0.0763)	
Equity/Assets	0.1195	0.0977	(-0.2457)	
Singapore	Internet=0 [1]	Internet=1 [2]	t-test [2]-[1]	
Interest Income/Assets	.	0.0138		
ROA	3.6000	1.0677	(-33.8142)	***
ROE	3.8000	11.8000	(5.7143)	**
Assets	21.9000	289015.4333	(4.8174)	**
Cash/Assets	0.1219	0.0573	(-1.5607)	
Securities/Assets	0.0090	0.0387	(0.7419)	
Loans/Assets	0.4240	0.4029	(-0.0853)	
Deposits/Assets	0.6247	0.6708	(0.7305)	
Other Liabilities/Assets	0.0000	0.0606	(0.6366)	
Equity/Assets	0.9498	0.0912	(-125.404)	***
Thailand	Internet=0 [1]	Internet=1 [2]	t-test [2]-[1]	
Interest Income/Assets	0.0305	0.0298	(-0.1068)	
ROA	2.0500	1.1742	(-1.8293)	
ROE	20.1000	12.0240	(-1.6348)	
Assets	82045.4000	36414.8600	(-1.3459)	
Cash/Assets	0.0156	0.0174	(0.2115)	
Securities/Assets	0.0267	0.0239	(-0.1177)	
Loans/Assets	0.6907	0.6222	(-0.4056)	
Deposits/Assets	0.7479	0.6784	(-0.7853)	
Other Liabilities/Assets	0.0786	0.0434	(-0.8605)	
Equity/Assets	0.1060	0.1031	(-0.1241)	

Note：1. ***, **, and * indicates 1%, 5%, and, 10% level of significance respectively.
2. All banks in Taiwan and China provided internet banking service therefore were not fit for the test.

Table 4-7 The Significance of ΔFinancial Data in the East-Asian 10 countries during 2014-2016: Full sample

Financial data	Internet=0 [1]	Internet=1 [2]	t-test [2]- [1]	
Interest Income/Assets	-0.0028	-0.0005	(1.3678)	
ROA	-0.0347	-0.2446	(-0.7211)	
ROE	-2.6419	-2.3924	(0.1303)	
Assets	-2318.0842	19455.3477	(1.9168)	*
Cash/Assets	-0.0182	0.0032	(1.4097)	
Securities/Assets	0.0114	-0.0008	(-3.6544)	***
Loans/Assets	-0.0295	-0.0028	(0.9422)	
Deposits/Assets	-0.0739	-0.0149	(1.7131)	*
Other Liabilities/Assets	0.0001	0.0007	(0.1561)	
Equity/Assets	0.0161	-0.0006	(-1.088)	

Note: ***, **, and * indicates 1%, 5%, and, 10% level of significance respectively.

Table 4-8 The Significance of ΔFinancial Data in the East-Asian 10 countries during 2014-2016

Hong Kong	Internet=0 [1]	Internet=1 [2]	t-test [2]- [1]	
Interest Income/Assets		0.0001		
ROA	3.2000	-1.2014	(-1.5433)	
ROE		-4.8220		
Assets	-142.5000	3492.5455	(0.5231)	
Cash/Assets	0.0187	0.0069	(-0.1018)	
Securities/Assets	-0.0100	0.0044	(2.9599)	**
Loans/Assets	0.0000	-0.0198	(-1.1914)	
Deposits/Assets	0.0000	-0.0141	(-0.6234)	
Other Liabilities/Assets	0.0008	-0.0057	(-0.336)	
Equity/Assets	-0.1000	-0.1279	(-0.1052)	
Indonesia	Internet=0 [1]	Internet=1 [2]	t-test [2]- [1]	
Interest Income/Assets	-0.0030	0.0055	(1.9172)	*
ROA	-0.4055	-0.8743	(-0.5823)	
ROE	-3.7543	-6.8206	(-0.577)	
Assets	467.2750	1262.2433	(0.8342)	
Cash/Assets	-0.0183	-0.0184	(-0.0058)	
Securities/Assets	0.0157	0.0013	(-1.8772)	*
Loans/Assets	-0.0078	-0.0160	(-0.4934)	

Deposits/Assets	-0.0376	-0.0200	(1.3931)
Other Liabilities/Assets	0.0004	0.0039	(0.8954)
Equity/Assets	0.0345	0.0258	(-0.5768)
Japan	Internet=0 [1]	Internet=1 [2]	t-test [2]- [1]
Interest Income/Assets	-0.0054	-0.0007	(2.8725) ***
ROA	0.0800	-0.0155	(-0.3424)
ROE	1.9200	-0.1839	(-0.6239)
Assets	-24561.5000	16255.6814	(1.3517)
Cash/Assets	-0.0191	0.0299	(1.8306) *
Securities/Assets	-0.0004	-0.0013	(-0.2757)
Loans/Assets	-0.3231	0.0262	(3.4311) ***
Deposits/Assets	-0.4435	0.0230	(3.4866) ***
Other Liabilities/Assets	-0.0059	-0.0018	(1.2652)
Equity/Assets	-0.0221	0.0012	(1.8553) *
South Korea	Internet=0 [1]	Internet=1 [2]	t-test [2]- [1]
Interest Income/Assets	-0.0020	-0.0037	(-0.2484)
ROA	0.1177	-0.3511	(-0.8306)
ROE	1.8900	-3.1545	(-0.8136)
Assets	17370.9000	7944.0455	(-1.5076)
Cash/Assets	0.0089	0.0006	(-0.6543)
Securities/Assets	0.0081	0.0013	(-0.9830)
Loans/Assets	-0.0153	-0.0756	(-0.3946)
Deposits/Assets	0.0360	-0.0630	(-0.6979)
Other Liabilities/Assets	-0.0056	-0.0086	(-0.4068)
Equity/Assets	-0.0025	-0.0216	(-0.5263)
Malaysia	Internet=0 [1]	Internet=1 [2]	t-test [2]- [1]
Interest Income/Assets	-0.0041	-0.0011	(2.0229)
ROA	0.0200	-0.3659	(-0.5628)
ROE	-1.5400	-5.4191	(-0.5308)
Assets	-10127.5000	-7467.9909	(0.4590)
Cash/Assets	-0.0250	-0.0141	(0.8086)
Securities/Assets	-0.0032	-0.0082	(-0.2259)
Loans/Assets	0.0634	0.0265	(-1.2373)
Deposits/Assets	-0.0773	-0.0241	(1.6601)
Other Liabilities/Assets	0.0404	0.0087	(-1.9209)
Equity/Assets	0.0066	0.0143	(0.8215)

Philippines	Internet=0 [1]	Internet=1 [2]	t-test [2]- [1]
Interest Income/Assets	-0.0002	-0.0013	(-0.5132)
ROA	0.1460	-0.0560	(-0.6121)
ROE	1.1900	-1.4446	(-1.4791)
Assets	133.6500	1621.0693	(1.1711)
Cash/Assets	-0.0042	-0.0808	(-0.549)
Securities/Assets	0.0188	-0.0121	(-1.9258) *
Loans/Assets	0.0862	-0.0324	(-0.8926)
Deposits/Assets	-0.0296	-0.0527	(-0.1420)
Other Liabilities/Assets	-0.0006	0.0037	(0.3011)
Equity/Assets	0.0109	0.0071	(-0.0521)
Singapore	Internet=0 [1]	Internet=1 [2]	t-test [2]- [1]
Interest Income/Assets		0.0004	
ROA	1.0400	-0.1387	(-15.7014) ***
ROE	1.0400	-2.1567	(-2.0865)
Assets	0.6000	-4991.7333	(-0.3469)
Cash/Assets	-0.0972	-0.0162	(2.4098)
Securities/Assets	-0.0014	0.0070	(2.6436)
Loans/Assets	0.0000	0.0094	(1.0833)
Deposits/Assets	0.0000	-0.0034	(-0.3504)
Other Liabilities/Assets	0.0000	0.0060	(1.6575)
Equity/Assets	0.0058	0.0060	(0.0289)
Thailand	Internet=0 [1]	Internet=1 [2]	t-test [2]- [1]
Interest Income/Assets	0.0003	0.0028	(0.4779)
ROA	-0.3700	0.1062	(0.8136)
ROE	-5.2000	-1.0230	(0.8680)
Assets	-653.3000	369.9000	(0.1433)
Cash/Assets	-0.0017	-0.0026	(-0.2573)
Securities/Assets	0.0035	0.0056	(0.1278)
Loans/Assets	0.0079	-0.0105	(-0.4789)
Deposits/Assets	-0.0065	-0.0405	(-0.7639)
Other Liabilities/Assets	0.0092	0.0161	(0.1475)
Equity/Assets	0.0087	0.0137	(0.4339)

Note: 1. ***, **, and * indicates 1%, 5%, and, 10% level of significance respectively.
2. All banks in Taiwan and China provided internet banking service therefore were not fit for the test.

Table 4-9 The Effects of Internet Banking on Performance (Internet Penetrance) in the East-Asian 10 countries: Full sample

	△Interest Income/Assets		△ROA		△ROE		△Assets		△Cash/Assets	
	-1		-2		-3		-4		-5	
Intercept	0.0141	***	-0.7764	**	-5.0192	**	-3360.75	*	-0.0559	***
	-4.4545		(-2.0281)		(-2.2793)		(-1.7384)		(-3.1399)	
Internet	0.0035	**	-0.4314		-3.6138	**	398.6266		-0.0235	*
	-2.0001		(-1.4964)		(-2.0576)		-0.2644		(-1.8918)	
Financial Data	-0.0002		0.083	**	1.188	***	462.5899	**	0.0081	***
-2014	(-0.9500)		-2.1075		-4.6071		-2.1843		-4.4734	
Δ Financial data	0		0		0	*	2.0121	***	0	
(2013-2014)	(-1.5978)		(-0.9286)		(-1.8867)		-68.2201		(-1.6090)	
Assets	-0.0149	***	0.5417	*	-0.6226		-753.001		0.0449	***
	(-6.2796)		-1.9003		(-0.3241)		(-0.4937)		-3.6725	
Equity	-0.0829		-56.9197	***	-17.6224	**	-0.1021	***	-0.23	***
	(-0.9288)		(-5.6005)		(-2.4422)		(-8.2774)		(-3.1042)	
Internet Penetration	-0.2671	***	-0.2367	***	-0.5397	***	-2.0123	***	-0.311	***
	(-6.2025)		(-2.7035)		(-6.7155)		(-65.6896)		(-7.5422)	
Adj-R^2	0.1137		0.0188		0.0296		0.1071		0.3744	
F-statistic	6.283	***	1.784	***	2.242	***	5.999	***	26.233	***

	△Securities/Assets		△Loans/Assets		△Deposits/Assets		△Other Liabilities/Assets		△Equity/Assets	
	-6		-7		-8		-9		-10	
Intercept	0.009	*	-0.0902	**	-0.0605		0.0015		0.0844	***
	-1.7782		(-2.0147)		(-0.9204)		-0.2764		-3.4981	
Internet	-0.0104	***	-0.0008		0.0309		0.0037		-0.0349	**
	(-2.7429)		(-0.0326)		-1.1235		-0.8867		(-2.5856)	
Financial data	0.0006		0.0115	***	0.0026		0		0.0012	
-2014	-0.946		-2.95		-0.5809		(-0.0501)		-0.5093	
Δ Financial data	0		0		0		0		0	
(2013-2014)	-0.5839		(-1.6497)		(-0.3145)		(-0.0548)		(-0.7128)	
Assets	-0.0049		-0.0298		0.0196		-0.0117	***	-0.0522	***
	(-1.3292)		(-1.2182)		-0.6967		(-2.8615)		(-3.9463)	
Equity	-0.0857		-0.006		-0.117	***	-0.1109	**	0.0119	***
	(-1.6073)		(-0.1276)		(-2.6395)		(-2.1755)		-3.1007	
Internet Penetration	-0.1321	***	-0.0288		-0.0485		0.1907	***	-0.3091	***
	(-4.3643)		(-0.6586)		(-0.7830)		-4.0668		(-7.8830)	
Adj-R^2	0.1137		0.0188		0.0296		0.1071		0.3744	
F-statistic	6.283	***	1.784	***	2.242	***	5.999	***	26.233	***

Note：1. ***, **, and * indicates 1%, 5%, and, 10% level of significance respectively.
2. Values in parentheses are t-test values.

Table 4-10 The Effects of Internet Banking on Performance (Internet Penetrance) in the East-Asian 10 countries

	ΔInterest Income/Assets	ΔROA	ΔROE	ΔAssets	ΔCash/Assets
	-1	-2	-3	-4	-5
Intercept	-0.0059 *	0.0375	-2.8436	-4588.09 *	-0.0379 *
	(-1.8988)	-0.0803	(-1.0008)	(-1.8101)	(-1.8643)
Internet	0.0043 ***	-0.4524	-4.152 **	957.0272	-0.0154
	-2.609	(-1.5446)	(-2.3588)	-0.6268	(-1.3238)
Equity	0.0004	0.0512	1.0132 ***	450.1837 *	0.0108 ***
	-1.381	-1.1486	-3.72	-1.9494	-5.9968
Assets	0	0	0 **	2.0407 ***	0
	(-1.3730)	(-0.8047)	(-2.0647)	-61.6884	(-1.1979)
Δ Financial data	-0.0116	-57.7164 ***	-12.0725	-0.1026 ***	-0.0887
(2013-2014)	(-0.1318)	(-5.3277)	(-1.5904)	(-7.9401)	(-0.9818)
Financial data	-0.3035 ***	-0.2817 ***	-0.6875 ***	-2.0419 ***	-0.3525 ***
-2014	(-7.1485)	(-2.7737)	(-7.1521)	(-59.5244)	(-8.7880)
China	0.0009	0.0137	4.7346 ***	-702.084	-0.0592 ***
	-0.6896	-0.063	-2.8638	(-0.4928)	(-6.1604)
Hong Kong	0.0029	0.1295	1.502	-806.549	-0.022
	-1.263	-0.3496	-0.6921	(-0.4294)	(-1.5504)
Indonesia	0.0155 ***	-0.5461 **	-0.8244	1055.445	-0.0113
	-8.1406	(-2.2692)	(-0.5465)	-0.8458	(-1.1960)
Korea	0.0005	0.0117	0.1833	1518.232	-0.0478 ***
	-0.2417	-0.0359	-0.0903	-0.8232	(-3.2468)
Malaysia	0.0016	-0.107	1.3734	1612.664	-0.0419 ***
	-0.8304	(-0.3311)	-0.6506	-0.8656	(-2.8880)
Philippines	0.0072 ***	-0.2078	3.158	281.5219	-0.0527 ***
	-3.8249	(-0.6440)	-1.65	-0.1739	(-4.0434)
Singapore	0.0017	0.1733	1.5087	7536.289 **	-0.0629 ***
	-0.4909	-0.3332	-0.4924	-2.5073	(-2.7601)
Taiwan	0.0007	0.0029	1.4614	-890.013	-0.0381 ***
	-0.4828	-0.012	-0.9658	(-0.6254)	(-3.2443)
Thailand	0.0097 ***	0.2157	3.6002 *	379.5133	-0.0475 ***
	-4.8525	-0.6675	-1.7676	-0.2058	(-3.2074)
Adj-R^2	0.274	0.2899	0.2877	0.9853	0.4762
F-statistic	7.606 ***	7.998 ***	7.894 ***	1209.17 ***	17.429 ***

	ΔSecurities/Assets	ΔLoans/Assets	ΔDeposits/Assets	ΔOther Liabilities/Assets	ΔEquity/Assets
	-6	-7	-8	-9	-10
Intercept	0.0052	-0.165 ***	-0.2022 **	-0.0075	0.0124
	-0.7414	(-2.9650)	(-2.2598)	-0.0028	-0.4206
Internet	-0.0098 **	0.0097	0.0437	-0.0001	-0.0271 **
	(-2.5854)	-0.394	-1.6397	0	(-2.0959)
EQUITY	0.0003	0.0185 ***	0.0144 ***	0.0018	0.003
	-0.5161	-4.2154	-2.8124	(-0.0065)	-1.1461
ASSETS	0	0	0	0.0062	0
	-0.8982	(-1.5376)	(-0.2743)	(-0.0110)	(-0.5591)
Δ Financial data	-0.0624	-0.0079	-0.1208 ***	0.0129 *	0.0152 ***
(2013-2014)	(-1.1086)	(-0.1708)	(-2.7902)	(-1.6758)	-3.8976
Financial data	-0.1573 ***	-0.0709	-0.0108	-0.0971 ***	-0.2605 ***
-2014	(-4.4353)	(-1.4131)	(-0.1540)	-3.3125	(-5.9517)
China	0.0027	-0.0539 ***	-0.0841 ***	0.0077	-0.0014
	-0.9256	(-2.7798)	(-4.2175)	-0.007	(-0.1364)
Hong Kong	0.0052	-0.0277	-0.0085	-0.0003	-0.0643 ***
	-0.974	(-0.8111)	(-0.2265)	-0.0068	(-3.7691)
Indonesia	0.0053 *	0.0513 **	0.0457 *	0.0129 *	0.0467 ***
	-1.7006	-2.501	-1.8936	(-0.0971)	-4.3761
Korea	0.0054	-0.0636 **	-0.0413	0.1809 **	-0.0166
	-1.2183	(-2.2056)	(-1.2558)	(-2.1728)	(-1.0684)
Malaysia	-0.0015	0.0335	-0.0134	-0.011	0.0214
	(-0.3096)	-1.1541	(-0.4227)	-1.5397	-1.38
Philippines	-0.0042	0.0231	-0.0053	0.0077	0.0053
	(-1.0428)	-0.9048	(-0.1844)	-1.6266	-0.3852
Singapore	0.0078	-0.0176	-0.016	0.007	0.0638 **
	-1.092	(-0.3417)	(-0.2830)	(-0.0367)	-2.3867
Taiwan	0.0075 *	0.0009	0.0203	-0.0003 *	0.0076
	-1.937	-0.0399	-0.8177	-1.803	-0.6354
Thailand	0.0095 **	0.0131	-0.0127	0.0068 **	0.0218
	-2.1397	-0.4557	(-0.3904)	-2.5067	-1.4055
Adj-R^2	0.1335	0.0729	0.1	0.1358	0.4411
F-statistic	3.717 ***	2.377 ***	2.937 ***	3.806 ***	15.26 ***

Note: 1. Japan is presented as the intercept.
2. ***, **, and * indicates 1%, 5%, and, 10% level of significance respectively.
3. Values in parentheses are t-test values.